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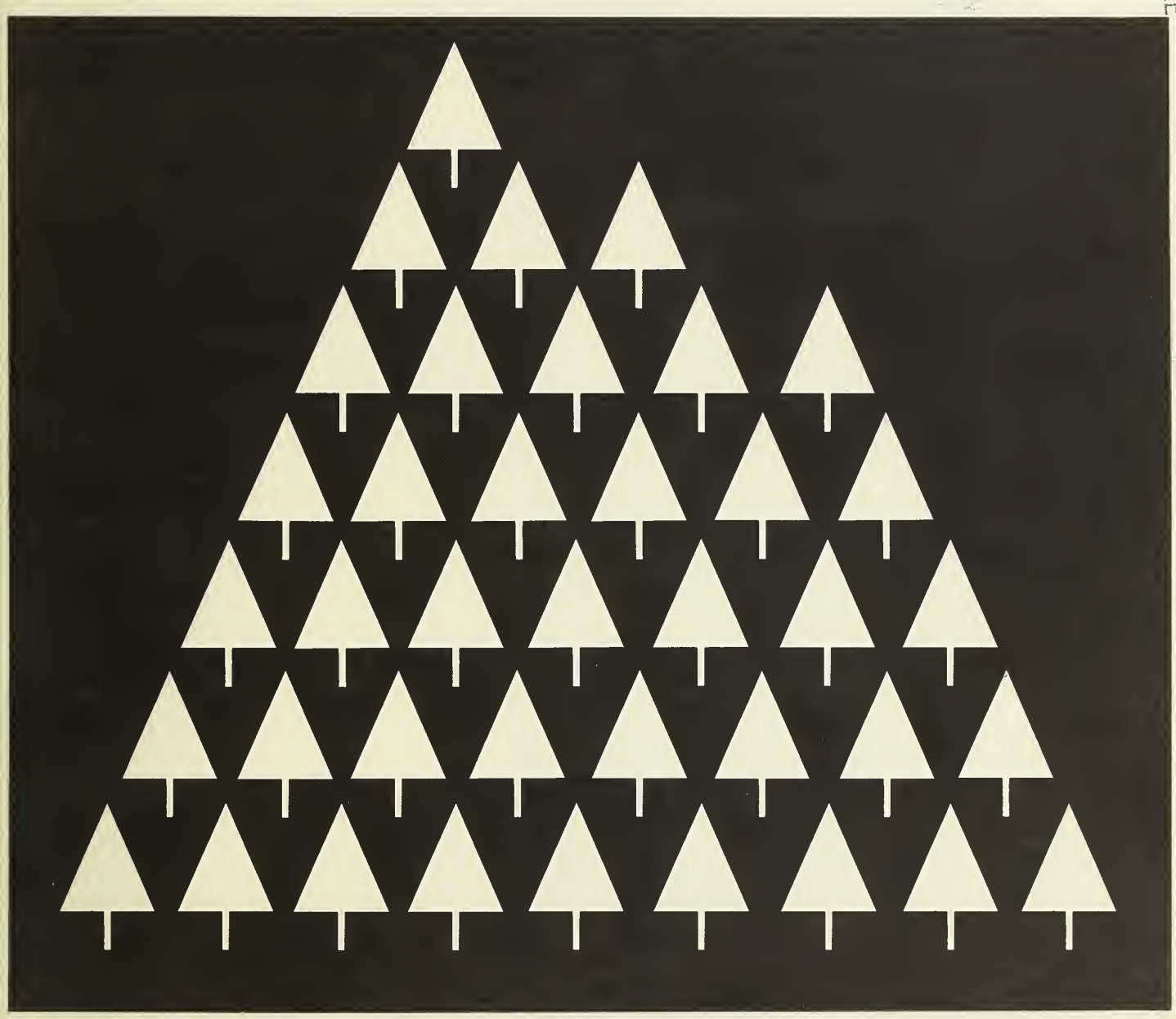
United States
Department of
Agriculture

Forest Service

**Forest
Products
Laboratory**

1980/1

Dividends From Wood Research



CONTENTS

Dividends From Wood Research

Dividends From Wood Research is a semiannual listing of recent publications resulting from wood utilization research at the Forest Products Laboratory. These publications are made available to the public to encourage private and commercial application of Forest Service research. The Forest Products Laboratory is maintained in Madison, Wisconsin, by the Forest Service, U.S. Department of Agriculture, in cooperation with the University of Wisconsin.

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Wood Bridges--Decay Inspection and Control

Eslyn, Wallace E., and Joe W. Clark
U. S. Dep. Agric., Agric. Handb. 557, 32 p. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Stock Number: 001-001-00484-7. $1.75.

This handbook is directed toward engineers, wood products pathologists, educators, and those involved in bridge inspection and maintenance work. It discusses the causes, occurence, evidence and detection of wood decay, as well as the assessment of associated strength loss, natural and induced resistance to decay, and inspection and maintenance of wood bridges.

It is a revision of a handbook on wood bridge decay inspection prepared by the authors for the Engineering Staff of the Forest Service, U. S. Department of Agriculture, in reponse to 1971 legislation requiring all Federal-aid-system bridges to be inspected for safety at least every 2 years.

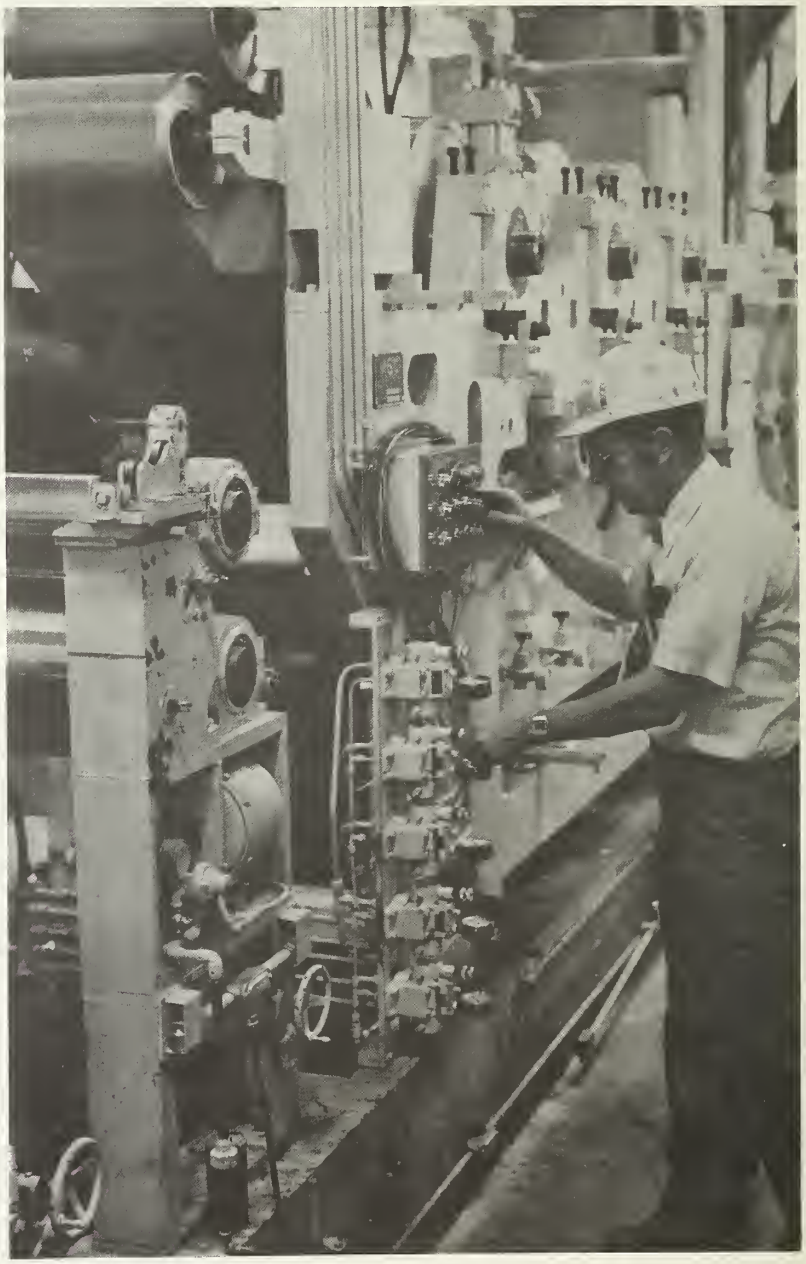
1

Press Drying: Flow and Adhesion of Hemicellulose and Lignin

Byrd, Von L.
Tappi 62(7):81-84. 1979.

Press drying is a new paper making process whereby the wet sheet coming off the paper machine is simultaneously pressed and dried. It maximizes interfiber bonding and paves the way for extending the use of high-yield hardwood pulps. The future of press drying depends greatly on using those raw materials (pulps) that work best in the process and produce the desirable properties.

This article discusses the test results obtained from using a new technique to determine the effects of varying the content of hemicellulose and lignin 1) on the strength of conventional and press dried paper, 2) on the flow and adhesion characteristics of hemicellulose and lignin during press drying and 3) the role of lignin in producing wet strength during press drying.



2 **Performance of Wood In a Do-It-Yourself Solar Collector**

Sherwood, G. E., and W. A. Gatz
USDA For. Serv. Res. Note
FPL-0240. 1979.

The search for economical methods of collecting solar energy has led to a variety of systems, many of them using wood as a basic construction material. But what about the durability and safety of wood at the temperatures involved? To test conditions such as might be involved in a home-built solar energy collector, variations of a simple collector design were tested near Madison, Wis., from January through December 1977. Air was not allowed to circulate, in order to reach maximum temperatures. Even under such stagnation conditions, temperatures only briefly reached 200°F in a few situations. Therefore, under normal operating conditions, with a flow of air over the wood members, there would be little chance of spontaneous ignition. Some other performance details of the collectors are listed in regard to condensation, corrosion of the metal, and damage to paint and plastic used.

3 **Extractives in Eastern Hardwoods--A Review**

Rowe, John W., and Anthony H. Conner
USDA For. Serv. Gen. Tech. Rep.
FPL 18. 1979

This report extensively reviews the chemistry of extractives from the wood and bark of Eastern U.S. hardwods. Extractives are natural products important in utilization of these hardwoods, because they influence properties of wood and performance of wood products. Extractives can protect wood from decay, add color and odor to wood, accent grain pattern, and enhance strength properties. They can also contribute to corrosion of metals in contact with wood; inhibit setting of concrete, glues, and finishes; cause problems in papermaking; present health hazards; and affect color stablity of wood to light.

Hardwoods in this review are grouped and discussed alphabetically by their respective botanical families enabling chemotaxonomic inferences related to genera. Literature searches cover 22 families and 174 species.

4 **Structural Sandwich Performance After 31 Years of Service**

Palms, Jerome, and Gerald E. Sherwood
USDA For. Serv. Res. Pap. FPL 342. 1979

This final report on the Forest Products Laboratory's 31-year evaluation of the performance of sandwich panels includes information useful to building manufacturers, building code authorities, and others concerned with design and manufacture of housing.

Made of low-density core material bonded to thin, high-strength facing materials, sandwich panels are used as wall, roof, or floor elements in housing. In 1947 the Lab erected an experimental unit to monitor the actual in-service performance of these panels. This report documents the cumulative test results and presents a summary analysis of the tests and other recorded data.

Anatomy & Properties

5 **Mean and Tolerance Limit Stresses and Stress Modeling for Compression Perpendicular to Grain in Hardwood and Softwood Species**

Bendtsen, B. Alan, and William L. Galligan
USDA For. Serv. Res. Pap. FPL 337. 1979

This paper attempts to provide a more practical and useful criterion for C-perp (compression perpendicular to grain) behavior in wood. Up to now, C-perp allowable stresses published in codes and standards are so conservative that contractors are sometimes forced to limit truss spans or use excessive numbers of steel bearing plates to meet requirements. Tables characterizing the stress-compression relationship of C-perp in several species are included.

6 **Evolution of Allowable Stresses in Shear for Lumber**

Ethington, Robert L., William L. Galligan, Henry M. Montrey and Alan D. Freas
USDA For. Serv. Gen. Tech. Rep. FPL 23. 1979.

With the advent of more thorough methods of analysis, computer designs, more complex structures, and composite products containing wood, engineers are taking a new look at allowable shear stresses. This paper should provide helpful background for engineering groups charged with improving allowable property assignments for lumber and other wood products. Tieing together bits of historical evidence from unpublished letters, memoranda and notes, the paper presents a unique survey of the research leading to parallel-to-grain allowable shear stress for lumber.

Buildings & Construction

7 **Smoldering Combustion Tendency: An Introduction**

Schaffer, Erwin L.
J. of Thermal Insulation 2(1): 135-140. 1979.

This paper outlines the difficulties in developing a test method to measure the tendency for smoldering to occur and in establishing the criteria to measure test results. Smoldering is the combustion of solid materials without flame and sometimes without glowing. It is a complex phenomenon to analyze and control. Although the evidence is clear that fires can start through smoldring, only recently have smoldering-initiated fires in construction been investigated to any large degree.

8 **Bending Strength of Vertically Glued Laminated Beams with One to Five Plies**

Wolfe, Ronald W., and Russell C. Moody
USDA For. Serv. Res. Pap. FPL 333. 1979.

Comparison of the strength of a vertically laminated beam with the strength of component pieces of lumber forms the basis for design specifications. If beam strength is consistently estimated too low, wastefully oversized beams are required in building.

This study adds considerably to information on the subject; experimental results showed current estimation procedures to be conservative, as expected. Values became extremely conservative for multiple member beams made from lumber of the lowest accepted grade. Date offered here should provide valuable guidance for any future review of design values.

9 **Racking Strength of Wood-Frame Walls**

Tuomi, Roger L.
In National Bureau of Standards Publication No. 523, p. 25-34. 1978.

Racking strength of a wall system is defined as its ability to resist horizontal inplane shear forces. Such forces arise primarily from wind but are also present under earthquake conditions. Rather than the customary performance testing, a new analytical method appears promising for predicting racking performance of a structure. New testing apparatus has been designed to make possible future evaluations of racking stiffness.

10 **Bending Strength of Large Alaskan Sitka Spruce and Western Hemlock Log Bridge Stringers**

Tuomi, R. L., R. W. Wolfe, R. C. Moody, and F. W. Muchmore
USDA For. Serv. Res. Pap. FPL 341. 1979

Native log stringer bridges are important and practical structures for logging roads in remote areas of Alaska. But current knowledge of the strength of large logs is extremely limited. To obtain actual data, 40 large logs were tested to destruction in a field test facility. These were probably the largest logs ever tested--with butt diameters up to 4 feet, 10 inches and ultimate bending loads of more than 120,000 pounds. Values for both Sitka spruce and western hemlock showed average breaking strength at levels reasonably close to those obtained by current design procedure.

11 **Intercomparisons of Laboratory Determinations of Airborne Sound Transmission Loss**

Jones, Robert E.
J. Acoustical Society of America 66(1): 148-164. 1979.

This article briefly highlights the evolution of the American Society for Testing and Material (ASTM) Standard Designation E 90, "Laboratory Measurement of Airborne-Sound Transmission Loss of Building Partitions." It emphasizes improvements in methodology, accuracy, and precision, which sets the stage for some new E 90 accuracy concerns. Some suggested approaches for further study and solutions to these problems also are discussed in this paper.

12 **Wood-Stud Wall System: Performance and Probabilistic Design for Compression-Bending Loads**

Polensek, Anton, and David S. Gromala
In Behavior of Building Systems and Building Components. Vanderbilt Univ., Dept. Civil Eng., Nashville, Tenn., p. 177-194. 1979.

This paper summarizes research to develop an accurate analysis procedure for wood-stud walls. The authors develop a theoretical procedure for identifying the most important mechanisms associated with structural behavior of wood-stud wall systems, and the theory is verified experimentally.

13 **Strength of Log Bridge Stringers After Several Year's Use in Southeast Alaska**

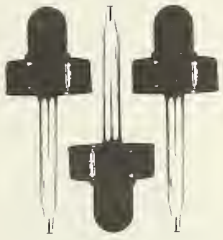
Moody, R. C., R. L. Tuomi, W. E. Eslyn, and F. W. Muchmore
USDA For. Serv. Res. Pap. FPL 346. 1979.

This paper reports on reseach conducted to determine the relative strength and stiffness of log stringers after 12 years of service in temporary bridges in southeast Alaska. The information included is helpful to engineers with the responsibility of rating the load capacity of bridges having untreated log stringers.

14 **Evaluation of Glued Laminated Beams of Eastern Spruce and Eastern Hemlock**

Shuler, Craig E., Donald A. Grant, and Russell C. Moody
Forest Prod. J. 29(7): 23-28. 1979.

This report presents results from critical testing of the structural properties of glued laminated beams made from eastern spruce and eastern hemlock. In cooperation with the Forest products Laboratory, the research was undertaken by the School of Forest Resources, University of Maine, where research in wood products has for many years emphasized improved utilization of species in the northeastern United States.



Chemistry

15 **Determination of Dimensional Stabilization of Wood Using the Water-Soak Method**

Rowell, Roger M. and W. Dale Ellis
Wood and Fiber 10(2): 104-111. 1978.

Many treatments to reduce the swelling of wood in contact with moisture are based on bulking the wood cell walls with some material to keep wood in a swollen state, unable to expand or contract further in response to water contact. When materials that do not chemically bond with the wood cell walls have been used to bulk them, contact with water can leach out these materials. The purpose of the paper is to describe a method for determining the dimensional stability resulting from bonded and nonbonded cell-wall bulking treatments as well as from lumen fill treatments.

16 **Highlights in Wood-Related Literature for 1978: Wood Chemistry "Distillates"**

Chang, H-m., W. J. Connors, C. W. Dence, and J. F. Saeman
Tappi 62(7): 63-65. 1979.

Of interest to the paper industry and wood chemists are these highlights from an annual review of wood chemistry and related literature. Included is 1978 literature of wood-related research reviewed for the significant areas of lignin biodegradation, molecular weight determination of lignin, and pulping additives.

17 **Colorimetric Determination of Hexuronic Acids in Plant Materials**

Scott, Ralph W.
Analytical Chemistry 51(7): 936-941. 1979.

This article reports on a study to develop a colorimetric method very specific for hexuronic acid in the presence of neutral sugars, particularly glucose, mannose, and xylose. A colorimetric reagent, 3-5-dimethylphenol, is reported here to be selective for 5-formyl-2-furancarboxylic acid, a chromogen formed from uronic acids in concentrated H_2SO_4 at 70°C. Critical selectivity for additional uronic acids is discussed.

Degradation & Protection

18 **An Economic Comparison of Chip Storage Methods**

Springer, Edward L.
Tappi 62(9): 39-42. 1979.

A number of different methods have been proposed for managing wood chip inventory in kraft pulp millyards. The first-in-first-out (FIFO) procedure has been recommended for reducing deterioration of coniferous species during outside ship storage. The last-in-first-out (LIFO) procedure is by far the easiest to use; chips are simply added to and removed from the top of a single storage pile. However, LIFO is not a recommended procedure because of possible serious chip deterioration from long storage in the pile base. Recently a procedure called standby storage has been proposed as the optimum method for managing inventories of southern pine chips, with resulting significant monetary savings.

This article compares these three storage methods and identifies the one best suited for use with unscreened, clean, debarked southern pine chips.

19 **Chemical Modification of Wood: Reaction of Methyl Isocyanate with Southern Pine**

Rowell, R. M., and W. D. Ellis
Wood Science 12(1): 52-58. 1979.

Chemicals bonded to wood cell wall components can, among other things, improve the dimensional stability of wood and its resistance to rot. This paper sets down specific requirements for chemical reagents in wood modification. The chemical methyl isocyanate is tested as a wood modifier under these stated requirements, which includes determining whether the chemical reacts with wood cell components and examining the properties of the resulting modified wood. Test results are reported here.

20 **Forest Products Laboratory Natural Finish**

Black, John M., Don F. Laughnan, and Edward A. Mraz
USDA For. Serv. Res. Note FPL-046. Revised 1979.

A simple and durable natural finish for exterior wood, developed at the Forest Products Laboratory, is described. Directions for preparation are included as are recommendations for application to both smooth and rough wood surfaces. This finish is classified as a semi-transparent, oil-base penetrating stain that effectively retains much of the natural grain and texture of wood.

21 **Lateral Flow in Beech and Birch as Revealed by the Electron Microscope**

Murmanis, Lidija, and M. Chudnoff
Wood Sci. Technol. 13: 79-87. 1979.

Without lateral movement of fluids in wood, timbers could not be adequately treated with preservatives because of low retention and poor distribution of the chemicals in the wood. This study uses an electron microscope to explore the lateral penetration path in beech and birch. Findings relate to the distribution of wood preservatives in pressure-impregnated timbers and suggest that polar liquids may flow from cell to cell by two routes: the pit system and the cell wall capillary system.

22 **Resistance of Alkylene-Oxide-Modified Southern Pine to Attack by Subterranean Termites**

Rowell, R. M., S. V. Hart, and G. R. Esenther
Wood Science 11(4): 271-274. 1979.

Because wood treated with alkylene oxide effectively resisted fungi attack, tests were conducted to determine if chemically modified wood might also be effective in preventing attack by termites. Results from a 2-week laboratory test indicate that dry southern pine sapwood modified to 34 percent weight gain with propylene oxide and up to 34 percent butylene oxide resisted attack by subterranean termites. Resistance of modified wood seem attributable to unpalatibility rather than repellence of toxicity.

23 **Protection of Wood Surfaces with Chromium Trioxide**

Feist, William C.
USDA For. Serv. Res. Pap. 339. 1979.

Chromium trioxide ($Cr0_3$) is applied to unfinished wood for a number of beneficial results including greater decay resistance. This paper reports on research tests measuring the treatment effects with changes in solution concentrations, pH, treatment method, and treatment temperature. Test results confirm the value of $Cr0_3$ pretreatments in protecting wood surfaces.

24 **Termite Bioassays Show Greatly Varied Tolerances to Insecticide in Bait Blocks**

Esenther, Glenn R.
Forest Prod. J. 29(9): 55-56. 1979.

This study sought to provide guidelines in the selection of a field dosage for a bait insecticide to combat termites. Experiments reveal that termites show different tolerances to insecticide with different laboratory bioassay techniques; furthermore, termites appear more tolerant to an insecticide in their natural environments than in laboratory trials. Results indicate a tenfold increase over the highest threshold dosage of the best laboratory assay is a reasonable field dosage.

25 ***Laetisaria* (Aphyllophorales, Corticiaceae), A New Genus for the Teleomorph of *Isaria Fuciformis***

Burdsall, Harold H. Jr.
Trans. of British Mycol. Society 72(3): 419-422. 1979.

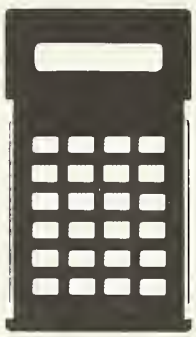
Several nomenclatural and taxonomic problems associated with the name *Isaria fuciformis* Berk. are investigated. A new generic name is proposed to accomodate *Hypochnus fuciformis* McAlp. and a new combination in *Athelia* is proposed for *Corticium fuciforme* Wakef.

26 **Comparative Distribution of Ectomycorrhizae in Soils of Three Western Montana Forest Habitat Types**

Harvey, A. E., M. J. Larsen, and M. F. Jurgensen
Forest Science 25(2): 350-358. 1979.

The relationship between various types of soil organic matter and ectomycorrhizal activity was examined in three forest ecosystems representing a range in available moisture. The date confirm that a major biological role is performed by the humus (O_2) and decayed wood (O_3) fractions of forest soils in that they support most ectomycorrhizae of forest trees in mature ecosystems.

Maintaining the maximum accumulation (particularly large wood material) consistent with reasonable fuel loadings appears to have considerable potential for enhancing site quality.



Design Data

27 **Evolution of Tensile Design Stresses for Lumber**

Galligan, William L., C. C. Gerhards, and R. L. Ethington
USDA For. Serv. Gen. Tech. Rep. FPL 28. 1979.

Until about 1965, allowable design stresses for lumber in tension were taken as equal to those asigned for bending. As interest in tensile properties increased, testing machines were designed specifically to stress lumber in tension. Research results accumulated on tension tests of full-size lumber suggested lower design stresses for tension than for bending--both for machine-stress rated lumber and visually graded lumber.

28 **Analysis of Orthotropic Beams**

Liu, J. Y., and S. Cheng
USDA For. Serv. Res. Pap. FPL 343. 1979.

This report presents a plane-stress analysis of orthotropic or isotropic beams that considers these loading conditions: (1) A concentrated normal load arbitrarily located on the beam and (2) A distributed normal load covering an arbitrary length of the beam.

Each of the infinite series in the solutions has been reduced to the sum of a finite series and a closed form, making it possible to obtain accurate numerical results using a computer of relatively small capacity.

The method is useful in predicting the stress distributions in a beam, especially in the vicinity of a support or a nominal load point.

General

29 **Production and Marketing Feasibility of Parallel-Laminated Veneer Products**

Youngquist, John A., and Ben S. Bryant
Forest Prod. J. 29(8): 45-48. 1979.

This paper reports an in-depth investigation into various opportunities for the sale of Press-Lam products and lists the most promising current markets. Press-Lam panels are made of parallel-laminated, rotary-peeled veneer sheets bonded together with adhesive. This process can provide thick, wide panels from small-diameter sawlogs.

30 **Business and Economic Information Available for Market Planning**

Kallio, Edwin, and Edward Dickerhoof
Forest Prod. J. 29(10): 61-66. 1979.

Business management needs reliable information to evaluate the current situation and make decisions about the future. Because literature related to forest products and their markets is so voluminous, the business manager must know where and how to select the appropriate sources of information. Such sources are generally described in this report, including some indication of the type of information to be available and how to gain access to it.

31 **The Small Woodland Owner**

Stone, Robert N.
Report of Small Woodland Owners Conference, July 20-21, 1978, St. Paul, Minn., p. 16-18.

At the present time, owners of small woodlands in the Lake States own 52 percent of the commercial forest land while producing 58 percent of the cut and 53 percent of the sawtimber growth on such lands. This report concludes that all owners are willing to sell stumpage part of the time. To encourage greater sales, major factors changing owner intentions over time must be identified, such as owner awareness of accumulated value at the time ownership changes hands. The need for forestry assistance programs to incorporate the problems resulting from sequential ownership is also stressed.

32 **Increment Cores: How to Collect, Handle and Use Them**

Maeglin, Robert R.
USDA For. Serv. Gen. Tech. Rep. FPL 25. 1979.

This paper describes increment cores, their uses, and the use and care of the increment borer essential in obtaining good cores. A caution is also given concerning the tree damage boring can cause and suggestions are listed for minimizing such damage.

33 **USA (1979 World Wood Review)**

McKeever, David B., and James L. Howard
World Wood 20(7): 33. 1979.

The forest products industries in the United States enjoyed a good year in 1978 with levels of production of all major wood products, lumber, plywood, and particleboard being substantially above those of 1977. A decline in housing starts and general business activity slowed 1979 levels.

34 **Forest Products Research in the Forest Service**

Youngs, R.L.
Forest Prod. J. 29(10): 56-60. 1979.

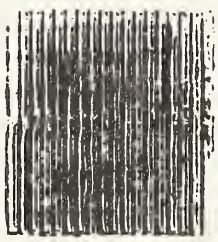
The forest products utilization research program of the Forest Service is designed to provide options and technologies for the more effective use of timber resources. Three-fourths of the program is centered at the Forest Products Laboratory and the rest at various Forest and Range Experiment Stations throughout the United States.

35 **Wood Utilization Priorities as Set by Energy and Materials Shortages**

Saeman, Jerome F., and Robert L. Youngs
From Proc. of Soc. of Amer. Foresters Convention, October 22-26, 1978, St. Louis, Mo., p. 451-455.

The authors propose that in wake of the renewed interest in wood for energy, basic research priorities should address better methods in producing pulp and paper, lumber, panel products, and fuelwood with emphasis on reducing energy requirements, utilizing the chemical values of trees, and improving the general quality of lumber.

Packaging



36 **A New Proposal for the Performance Testing of Shipping Containers**

Godshall, W. D.
Package Development and Systems, p. 21-23, Sept/Oct 1979.

Performance testing provides a rational basis for the evaluation of packaging materials and methods, and a means to determine levels of packaging that are both adequate and economical. This paper introduces a proposed practice for performance testing of shipping containers recently published by the American Society of Testing and Materials (ASTM). The recommended practice is based on the concept that each mode of transportation and portion of the distribution cycle has its unique set of hazard elements that a shipping container must endure and survive.

37 **Performance of Medium-Density Hardboard in Pallets**

Stern, R. K.
USDA For. Serv. Res. Pap. FPL 335. 1979.

This report should be of interest to anyone manufacturing, procuring, or using wood pallets. In this study, the basic engineering characteristics and performance of medium-density hardboard in pallets are compared to those of red oak lumber in pallets of similar design.

38 **Performance of Pallets with Hardboard Decks of Varied Density**

Stern, Robert K.
USDA For. Serv. Res. Pap. FPL 340. 1979.

The principal objective of this work was to develop information leading to successful use of hardboard for pallet construction and use. Notched stringer pallets 48 by 40 inches with red oak or hardboard decks were tested for handling impact, bending stiffness, and diagonal rigidity. Pallet durability results are promising enough to warrant further investigation of medium-density hardboard thicker than ¾ inch, especially for use in automatic palletizing operations.

39 **Optimum Fiber Distribution in Singlewall Corrugated Fiberboard**

Johnson, Millard W., Jr., Thomas J. Urbanik, and William E. Denniston
USDA For. Serv. Res. Pap. FPL 348. 1979.

One of the basic problems in the design of fiberboard containers is how to distribute the material between facings and corrugating medium to improve edgewise compression strength. The authors of this paper develop a theory they use to analyze the strength of a singlewall fiberboard element. The results are used to explain how to adjust facing and corrugating medium thicknesses to maximize edgewise compression strength.

Processing

40 **Drying Rate of Northern Red Oak Lumber as an Analytical Function of Temperature, Relative Humidity, and Thickness**

Tschernitz, John L., and William T. Simpson
Wood Science 11(4): 202-208. 1979.

This study sought to develop a simple analytical representation of the drying rate of a unit of commercial lumber as a function of temperature, relative humidity, and thickness to model kiln performance.

Drying rate data for red oak were collected, analyzed, presented, and then compared with previously reported drying rates for the same species. Results point out additional variables to consider and possible refinements in the mathematical modeling.

41 **California Black Oak Drying Problems and the Bacterial Factor**

Ward, James C., and Del Shedd
USDA For. Serv. Res. Pap. FPL 344. 1979.

This paper reports on a cooperative study between the Forest Products Laboratory and the Kimberly-Clark Corporation to explore the cause and extent of drying degrade in 4/4 black oak lumber from several different saw timber stands in Shasta County, Calif. Most drying degrade in this study was traced to heartwood that was weakened by anaerobic bacteria in the living tree, which the authors believe may be responsible for most of the unexpected drying degrade in California black oak lumber.

42 **Drying Procedures for Bacterially Infected Northern Red Oak Lumber**

McMillen, John M., James C. Ward, and Joseph Chern
USDA For. Serv. Res. Pap. FPL 345. 1979.

Bacterially infected heartwood of oak presents special drying problems when the wood is to be kiln-dried green from the saw. Infected oak is more prone to develop honeycomb and ring failure than healthy oak, even though dried under conventional or normally "safe" kiln schedules. This paper gives the results of more recent research to derive satisfactory procedures for drying infected 4/4 red oak under conditions milder than the kiln schedule for healthy oak.

43 **High-Temperature Drying of Hardwoods: A Progress Report on Current Research at FPL**

Boone, R. Sidney
From Proc. of Symp. on High-Temperature Drying of Hardwoods, March 22, 1979, New Albany, Ind., p. 25-40.

The possibilities of high-temperature drying techniques for hardwoods has attracted worldwide interest. In the early 1970's 9 of 12 hardwood species were dried at high temperatures from the green condition with no more increase in warp or other drying degrade than end-matched material dried at conventional temperatures. This exploratory study led to further investigation of this procedure. This progress report describes the promising work since that time with 4/4 lumber theoretically intended to be used as furniture stock. Thus far some pieces have dried well and defect-free, while others would have to be rejected for honeycomb, surface checks, because the blanks weren't dressed, or combinations of these difficulties. As expected, wood species is a factor.

44 **An Introduction to High-Temperature Drying: Past Research Efforts and Definitions of Terms and Procedures**

Boone, R. Sidney
From Proc. of Symp. on High-Temperature Drying of Hardwoods, March 22, 1979, New Albany, Ind., p. 1-9.

High-temperature drying is the kiln-drying of wood at dry-bulb temperatures of 212°F or higher. Though not new for softwoods, high-temperature drying techniques for hardwoods are largely in the research stage and their success depends heavily on wood species.

This paper discusses the use of high-temperature drying, its advantages and disadvantages, and research efforts with hardwoods since the early 1950's. A summary of terms and procedures commonly used with hardwoods is also provided.

45 **Solar-heated, Forced-air, Lumber Dryer for Tropical Latitudes**

Tschernitz, John L., and William T. Simpson
Solar Energy 22: 563-566. 1979.

The solar dryer described is a prototype of a design developed by the Forest Products Laboratory for the Agency for International Development, Department of State. The purpose of the project was to decide if solar energy could be used to improve drying of lumber in developing nations and if so, to design a dryer. Assuming electrical power is available, the design uses forced-air circulation in the dryer and collector to avoid the problems associated with natural-convection air flow.

46 **Cost of Grading Lumber by the Machine-Stress-Rating Process**

Ince, Peter J.
Forest Prod. J. 29(10): 80-83. 1979.

A number of lumber mills in North America have adopted machine-stress-rating systems for lumber grading. This paper reports on estimated 1978-level costs of high-speed machine-stress-rating lumber grading, based on a study of personnel and equipment requirements of seven operational mills, assuming various hypothetical levels of lumber handled.

47 **Preventing Veneer Bolt Spinout**

Fronczak, Frank J.
In Modern Plywood Tech., Proc. of the Seventh Plywood Clinic, Portland, Oreg., p. 22-27. 1979.

When the chucks in the ends of a veneer bolt fail to turn the bolt, or even hold it, the lathe operator has an all-too common problem. A log that might have been peeled into high-value veneer must be hogged into fuel or chipped for particleboard. Furthermore, must of the time spent in sorting, heating, loading, and starting the peeling process is wasted. Solutions to spinout vary from better chucks, to log heating, type of pressure bar, and lathe settings. This work covers the effect of chuck design on spinout, showing that design does make a difference.

48 **Sawmilling Roots**

Hallock, Hiram
In Electronics in the Sawmill, Proc. of Electronics Workshop, Sawmill and Plywood Clinic, Portland, Oreg., p. 7-13. 1979.

Traces the development of sawmilling from the origin of the saw, improvements in metal saws and saw frames, development of circular saws and replaceable teeth, to bandsaws, and recently, marriage with electronics. As a result, computer sawing and electronic controls appear to be here to stay.

49 **The Effect of Log Taper on Lumber Recovery**

Hallock, Hiram
In Modern Sawmilling Techniques, Proc. of Ninth Sawmill Clinic, Portland, Oreg., p. 72-78. 1979.

Taper in a log naturally affects the amount of lumber to be recovered when it is sawed. Because logs are usually bought in advance of sawing, a system of measurement must be capable of estimating lumber content using the only information available--log diameter and length. A fundamental difference in scaling systems (board foot or cubic scaling) deals primarily with their sensitivity to taper. This report seeks to explain the mathematical relationship of taper to scaling.

50 **Could S-D-R Be the Answer to the Aspen Oversupply Problem?**

Maeglin, Robert R.
Northern Logger and Timber Processor, July 1979, p. 24-25.

This article discusses the potential of S-D-R (Saw, Dry and Rip) process to elevate aspen to the role of a major stud supplier in the northern and easten markets. S-D-R is a procedure developed at the Forest Products Laboratory in which logs are sawn into flitches, dried, and ripped into studs. When flitches are dried at high temperatures in the S-D-R system, the studs are cut straight and stay straight.

Pulp & Paper

51 **Bonding in Press-Dried Sheets from High-Yield Pulps: The Role of Lignin and Hemicellulose**

Horn, Richard A.
Tappi 62(7): 77-79. 1979.

Press drying is a new paper making process whereby wet sheets coming off the paper machine are simultaneously pressed and dried. It extends the use of high-yield hardwod pulps by maximizing interfiber bonding. The author of this article proposes that hemicelluloses are primarily responsible for the high strength properties of press-dried pulps, and that compression creep properties of press-dried pulps are a result of lignin flow. The proposal is based on a study of the mechanism of interfiber bonding in press-dried redgum pulps of varied hemicellulose and lignin content.

52 **Drying and Heat Transfer Characteristics During Bench-Scale Press Drying of Linerboard**

Byrd, Von L.
USDA For. Serv. Res. Pap. FPL 338. 1979.

Press drying is a new paper making process whereby the wet sheet coming off the paper machine is simultaneously pressed and dried. It maximizes interfiber bonding and paves the way for extending the use of high-yield hardwood pulps. This study was initiated to quantify the drying and heat transfer rates which are obtained on a bench scale with the static flat press currently used at the Forest Products Laboratory for press drying experiments. These drying and heat transfer rates are integral to the design of a continuous prototype press dryer.

53 **Partial Delignification of Unbleached Kraft Pulp with Ligninolytic Fungi**

Kirk, T. Kent and H. H. Yang
Biotechnology Letters 1(9): 347-352. 1979.

Wood pulp produced by the kraft process generally has a characteristic brown color because of the residual, modified lignin it contains. Normally this residual kraft lignin is removed commercially by bleaching with chlorine and chlorine oxides. This requirement for bleaching chemical was reduced in this study when unbleached kraft pulp was partially delignified on incubation under specified conditions with ligninolytic fungi. While such biological bleaching as described is too slow, there are possibilities to increase the rate.

Residues & Energy

54 **Impacts of Energy Developments on Utilization of Timber in the Northwest**

Zerbe, John I.
From Proc. of Northwest Private Forestry Forum, Portland, Oreg., p. 47-49. 1978.

The paper reviews the options of wood use for fuel and as a substitute for petrochemical products. Using wood for fuel in the generation of electricity and steam for domestic and industrial heating is proposed as a viable wood for energy use. Auto manufacturing and housing are industries in which the author foresees an increase in wood use as a petrochemical substitute. He concludes that the Northwest forests will play a crucial role in decreasing our dependency on foreign energy.

55 **Meeting the Energy Demand Through Efficient Use of Wood**

Youngs, Robert L.
Presented at 69th Western Forestry Conf., of the Western Forestry and Conserv. Assoc., Woodlake Inn, Sacramento, Calif., Dec. 5-7, 1978. 6p.

Today, wood is a major energy source only in the forest products industries, even though burning for fuel in households is increasing. But the most important contribution timber can make to our economy is its use as a material rather than a fuel. It would require a substantial increase in fossil fuels for aluminum and steel to replace the 60 million tons of lumber and plywood that are consumed annually in the United States--or for plastics to replace our consumption of 65 million tons of paper and paperboard. The new situation of high energy prices favors wood because of the comparatively low energy requirements of forest products.

56 **Key Factors in the Hydrolysis of Cellulose**

Saeman, Jerome F.
Chemical Congress ACS/CSJ
Preprint 24(2): 472-479. 1979.

The outlook for fuels and chemicals from biomasss is clouded and depends on the outlook for energy. Most proposals for the conversion of biomass to fuels and chemicals involve the hydrolysis of cellulose. This paper provides an overview of the key points relating to cellulose hydrolysis which should be useful to those concerned with optimizing the future use of resources.

57 **How to Estimate Recoverable Heat Energy in Wood or Bark Fuels**

Ince, Peter J.
USDA For. Serv. Gen. Tech. Rep.
FPL 29. 1979.

The fuel value of wood or bark depends on the amount of heat energy that can be recovered in direct combustion, and this varies with the moisture content and chemical composition of these fuels. This report is a summary of information which may be used to estimate recoverable heat energy from wood or bark fuel used in typical furnace or boiler or hot air combustion heat recovery systems.

Wood Materials

58 **Utilization of Red Oak Press-Lam as Upholstered Furniture Frame Stock**

Eckelman, Carl A., William L. Hoover, Ronald W. Jokerst, and John A. Youngquist
Forest Prod. J. 29(6): 30-40. 1979.

Developed by the Forest Products Laboratory, Press-Lam is a composite material made of parallel plies of veneer bonded together with adhesives. Because of its potential as furniture frame stock, Press-Lam made from low-grade red oak, was tested to determine pertinent machine and mechanical properties. This paper reports the results, which uncovered no problems that would prevent the material tested from being used as frame stock.

59 **Fire Performance of Structural Flakeboard from Forest Residue**

Holmes, Carlton A., Herbert W. Eickner, John J. Brenden, and Robert H. White
USDA For. Serv. Res. Pap. FPL 315. 1979.

This evaluation of the fire performance of a new structural flakeboard panel should interest architects, builders, and code officials. The material is a result of the Forest Service's program to develop products from logging residues left in the forest. These structural flakeboard panels can be used as exterior wall and roof sheathing, and for subflooring and other floor systems. This paper reports on the fire performance of the panels compared to three commercial structural flakeboards made from wood-mill residues or round wood. The experimental panels were made from Pacific Northwest logging residues and used in comprehensive physical and mechanical testing.

60 **Reel Wheels: An Application of Material Science**

Geimer, Robert L.
Forest Prod. J. 29(4): 44-48. 1979.

This paper identifies the processing variables important to manufacturing cable reel wheels from circular plates of flakeboard. The study illustrates the ability to custom-make reconstituted wood products into combinations of shapes, stiffness and strength which are almost limitless.

61 **Hardboards from Mixed Tropical Hardwoods**

Myers, Gary C.
Forest Prod. J. 29(5): 44-48. 1979.

In tropical countries the tree species cut for use in reconstituted wood products represent only 3-10 percent of the standing forest. Thus, these trees are harvested in a "pick and choose" method which is unsightly and wasteful. If a technology were developed that could refine all species, more normal harvest practices would be possible. This paper reports on a successful pilot-plant manufacture of hardwoods from simulated "run-of-the-woods" mixes of tropical hardwood logs.

62 **Red Oak Structural Particleboard**

Hunt, M. O., W. L. Hoover, D. A. Fergus, W. F. Lehmann, and J. D. McNatt
Forest Prod. J. 29(9): 43-49. 1979.

When particleboards are made from dense hardwoods, the panels have often been too heavy for traditional uses. Logically, this weight problem might be solved if a relatively lightweight, high-performance, structural particleboard could be made. Such a three-layer board with faces of alined particles was made of northern red oak furnish; its engineering and dimensional stability properties indicated great promise. This is important because red oak is underutilized now and exists in quantity close to major construction markets of the eastern United States.

63 **Flaking Alternatives**

Price, Eddie W., and William F. Lehmann
USDA For. Ser. Gen. Tech. Rep. WO, Washington, D.C. p. 47-68. 1979.

This paper analyzes experimental structural flakeboard panels made from southern logging residues under varying factors. These factors include the type of commercial flaker, tree species, resin content, and compression ratio. The authors attempt to determine which commercial flaker is best overall by analyzing the bending strength, linear expansion, modulus of elasticity, and thickness swell of the panels.

Listed below are recent publications from universities or individuals involved in extramural research with the Forest Products Laboratory. Copies are not available from the Laboratory, but may be obtained from the contacts listed following each publication.

Sorbitol and Related Polyol Complexes of Manganese (II), -(III), and -(IV); Redox and Oxygenation Equilibria

Richens, David T., Cecil G. Smith, and Donald T. Sawyer.
Inorganic Chemistry 18(3): 706-712. 1979.

Contact the Department of Chemistry, University of California, Riverside, Calif. 92521.

Elasticity theory of Plates and a Refined Theory

Cheng, Sun
J. of Applied Mechanics 56(3): 644-650. 1979.

Contact Professor Sun Cheng, Department of Engineering Mechanics, University of Wisconsin, Madison, Wis. 53706.

Second Moment Reliability Analysis of Fire Exposed Wood Joist Floor Assemblies

Woeste, F. E., and E. L. Schaffer
Fire and Materials 3(3): 126-131. 1979

Contact F. E. Woeste, Agricultural Engineering Department, Virginia Polytechnic Institute and State University, Blacksburg, Va. 24061.

Smoldering Combustion of Cellulosic Materials

Shafizadeh, Fred, and Allan G. W. Bradbury
Thermal Insulation 2(1): 141-152. 1979.

Contact Wood Chemistry Laboratory, University of Montana, Missoula, Mont. 59812.

Reversible Binding of Dioxygen by Tris (3,5-di-tert-butylcatecholato) Manganese (III) in Dimethyl Sulfoxide

Magers, Keith D., Cecil G. Smith, and Donald T. Sawyer
J. of the American Chemical Society 100(3): 989-991. 1978.

Contact the Department of Chemistry, University of California, Riverside, Calif. 92521.

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